



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

Address: COMMISSIONER FOR PATENTS

P.O. Box 1450

Alexandria, Virginia 22313-1450

www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/587,254	06/01/2007	Yasuhiro Omura	128834	4781
25944 7590 09/27/2010 OLIFF & BERRIDGE, PLC P.O. BOX 320850 ALEXANDRIA, VA 22320-4850				
EXAMINER				
KREUTZER, COLIN WRIGHT				
ART UNIT		PAPER NUMBER		
2882				
NOTIFICATION DATE		DELIVERY MODE		
09/27/2010		ELECTRONIC		

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

OfficeAction25944@oliff.com
jarnstrong@oliff.com

Office Action Summary**Application No.**

10/587,254

Applicant(s)

OMURA, YASUHIRO

Examiner

COLIN KREUTZER

Art Unit

2882

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 14 July 2010.
2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 30-38, 40, 42-49, 94, 95, 97-102, 120, 121, 123-126 and 128 is/are pending in the application.
4a) Of the above claim(s) _____ is/are withdrawn from consideration.
5) ☐ Claim(s) _____ is/are allowed.
6) ☒ Claim(s) 30-38, 40, 42-49, 94, 95, 97-102, 120, 121, 123-126 and 128 is/are rejected.
7) ☐ Claim(s) _____ is/are objected to.
8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
10) ☒ The drawing(s) filed on 01 June 2007 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB-08)
Paper No(s)/Mail Date _____
4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____

DETAILED ACTION

1. Acknowledgement is made of the amendments to claims 30, 40, 44, 94-95, 99, 120-121 and 125, and the cancellation of claims 39, 41, 50-93, 96, 103-119, 122, 127 and 129-146 received 7/14/2010. The objection to claim 120 and rejections of claims 30-32, 94 under 35 U.S.C. 112 are withdrawn in view of Applicant's remarks/amendments. Claims 30, 94 and 120 were amended to incorporate subject matter previously indicated as allowable by the Examiner. However, upon further review, new grounds of rejection are applied over the previously cited references. The Examiner apologizes for the inconvenience.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. **Claims 30-31, 35-38, 49, 94, 120** are rejected under 35 U.S.C. 103(a) as being unpatentable over Schuster (US 6,191,880, previously cited).

For claims 30, 94 and 120, Schuster teaches an optical system (fig.'s 5-6) including an illumination optical system 52-57 (taught with respect to a separate embodiment, fig. 5, col. 6 line 39-54 but also compatible with the projection system of fig. 6 as all components aside from radial polarizer 55 of the fig. 5 embodiment are conventional in lithographic apparatus, col. 6 lines 34-39) which illuminates a surface 58 to be illuminated, the optical system comprising:

a birefringent element 420, disposed in an optical path of the optical system (in the path of annular light beam 41, fig. 4a col. 5 lines 58-66), that achieves a substantially circumferential distribution or a substantially radial distribution as a fast axis distribution in a lens aperture (by centrally-symmetrical pressure stress, fig. 4c, col. 6 lines 2-11); and

an optical rotator 430 disposed on an image side of the birefringent element 420 and adapted to rotate a polarization state in the lens aperture (fig. 4d, col. 6 lines 21-24);

an exposure apparatus (fig. 6, col. 7 lines 13-25) comprising the optical system (birefringent element 420 and optical rotator 430 are located in radial polarization rotating optical arrangement 107, col. 7 lines 24-27) which effects exposure of a predetermined pattern (from reticle 101, analogous to reticle 58 of fig. 5) on a photosensitive substrate (having photoresist 109); and

a device fabrication method (microlithography, abstract) comprising:

preparing a photosensitive substrate (with photoresist 109); and exposing a pattern (from reticle 101, analogous to reticle 58 of fig. 5) to be transferred on the photosensitive substrate (having photoresist 109) through the optical system (fig. 6).

While Schuster teaches that the polarization rotating device can be located in the illumination system (col. 3 lines 23-27), Schuster does not explicitly state that the birefringent element is located at or near a position optically conjugate with the surface 58 to be illuminated, in an optical path of the illumination optical system.

However Schuster teaches that the feature which is critical to trouble-free

functioning of birefringent elements is that they be located at a position of moderate angles of divergences of the light rays (col. 7 lines 33-38).

In view of the above discussion, it would have been obvious to one of ordinary skill in the art at the time the invention was made to locate the birefringent element taught by Schuster at a position in the illumination system, such as at or near a position optically conjugate with the surface 58 to be illuminated, provided that the location satisfies the condition of having moderate angles of divergences for the light rays.

For claim 31, Schuster teaches that the birefringent element 420 includes an optically transparent member which is made of a uniaxial crystal material (quartz, col. 6 lines 2-4) and a crystallographic axis of which is arranged substantially in parallel with an optical axis (41 in fig. 4a) of the optical system (the claimed crystallographic axis arrangement being necessary in order to function as disclosed in fig. 4c, col. 6 lines 6-11), and wherein a beam bundle of substantially spherical waves (secondary light sources shown in fig. 4b) in a substantially circular polarization state is incident to the optically transparent member (via plate 410, fig. 4b col. 5 line 64- col. 6 line 4).

For claim 35, Schuster teaches that the birefringent element includes an optically transparent member 420 which is located near a pupil of the optical system (fig. 6, where birefringent element 420 and optical rotator 430 are located in radial polarization rotating optical arrangement 107, col. 7 lines 24-27, which is located near a pupil of the system, col. 7 lines 37-41) and which includes internal stress substantially with rotational symmetry with respect to an optical axis of the optical system (centrally-symmetrical pressure stress, fig. 4c, col. 6 lines 2-11), and wherein a beam bundle in a

substantially circular polarization state is incident to the optically transparent member 420 (via plate 410, fig. 4b col. 5 line 64- col. 6 line 4).

For claim 36, Schuster teaches that the optical rotator 430 is located at a position where a beam bundle is incident thereto with variation of not more than 10° (almost completely collimated) in an angle of incidence (col. 7 lines 32-35).

For claim 37, Schuster teaches that the optical rotator rotates the polarization state in the lens aperture by about 45° (fig. 4d col. 6 lines 21-22).

For claim 38, Schuster teaches that the optical system includes a projection optical system 102-108 which forms an image of a first plane 101 on a second plane 109 (fig. 6).

For claim 49, Schuster teaches the optical system being an optical system for lithography (microlithographic projection exposure system, abstract).

4. **Claims 32-34** are rejected under 35 U.S.C. 103(a) as being unpatentable over Schuster (US 6,191,880) as applied to claim 30 above, and further in view of Omura (US 2004/0004771, previously cited).

For claim 32-34, Schuster teaches that a beam bundle of substantially spherical waves in a substantially circular polarization is incident to the birefringent element 420 as applied to claim 30 above.

Schuster does not teach an embodiment in which the birefringent element 420 includes at least a pair of optically transparent members made of a crystal material of the cubic system, wherein the pair of optically transparent members are so positioned

as to achieve the substantially circumferential distribution or the substantially radial distribution as the fast axis distribution in the lens aperture (claim 32),

or that the pair of optically transparent members are either:

arranged in a state in which a crystal orientation $\langle 111 \rangle$ is substantially parallel with an optical axis of the optical system and in which the other crystal orientations are relatively rotated by about 60° around the optical axis, or

arranged in a state in which a crystal orientation $\langle 100 \rangle$ is substantially parallel with an optical axis of the optical system and in which the other crystal orientations are relatively rotated by about 45° around the optical axis (claim 34).

Omura teaches a projection optical system and lithographic exposure apparatus (fig. 10 par. 2) which utilizes optical elements made of an optically transparent material of the cubic system (fig. 1 par. 12, 43-44), wherein a substantially circumferential distribution or the substantially radial distribution as the fast axis distribution is achieved (par. 68) by arranging two optical elements of the cubic system into one of the two arrangements recited above (par. 66) in order to provide the desired fast axis distribution while reducing unwanted influences of birefringence (par. 66).

It would have been obvious to one of ordinary skill in the art to modify the birefringent element of Schuster to include one of the two configurations taught by Omura in order to achieve a desired fast axis distribution while reducing unwanted birefringence effects.

5. **Claims 39-40, 42-44, 94-95, 97-99, 121, 123-125** are rejected under 35 U.S.C. 103(a) as being unpatentable over Schuster (US 6,191,880) as applied to claims

30, 94 and 120 above, and further in view of Levinson (Principles of Lithography, © 2001 SPIE Press, previously cited) *Note: a copy of the cited portion was attached with the previous action.*

For claims 39-40, 44, 94, 99, 121, 125, Schuster teaches that the optical system includes an illumination optical system 52-57 (taught with respect to a separate embodiment, fig. 5, col. 6 line 39-54 but equally compatible with the projection system of fig. 6 as all components aside from radial polarizer 55 of the fig. 5 embodiment are conventional, col. 6 lines 34-39) which illuminates a first (object) plane (reticle 58 or 101); and

a projection optical system (59 in fig. 5 or 102-108 in fig. 6) which forms an image of the first plane on a second (image) plane (61 or 109, respectively),

and that the birefringent element 420 is located on an optical path in either the projection system or illumination system (col. 7 lines 38-39) at a plane which is Fourier transformed to the image or object plane (i.e.- pupil plane) or in a plane equivalent thereto (col. 7 lines 39-41).

Schuster does not explicitly state that the optical system is telecentric on either the object or image side or that the optical path in which the birefringent element is located is telecentric on the first plane side.

Levinson teaches that as it was common for lithographic systems to be configured as both object and image side telecentric in order to reduce trapezoid magnification errors (fig. 6.13, p. 205 par. 2 – 206 par. 1).

It would have been obvious to one of ordinary skill in the art to recognize that the

apparatus taught by Schuster could be configured as a double telecentric system as taught by Levinson in order to reduce trapezoid magnification errors.

For claims 42-43, 97-98, 123-124, Schuster as modified by Levinson teaches that the illumination optical system forms a secondary light source including a predetermined optical intensity distribution 41 of an annular shape on an illumination pupil plane (fig. 4a, col. 5 lines 58-63), wherein an annular optical intensity distribution comprises an optical intensity in a pupil center region, being a region on the illumination pupil and including an optical axis, is smaller than an optical intensity in a region around the pupil center region.

6. **Claims 45-48, 100, 126** are rejected under 35 U.S.C. 103(a) as being unpatentable over Schuster (US 6,191,880) in view of Levinson (Principles of Lithography, © 2001 SPIE Press) as applied to claims 44, 99 and 125 above, and further in view of Gerhard (US 2002/0186462, previously cited).

For claims 45, 100, 126, Schuster teaches that the radial polarization arrangement 410-430 is located at an optical path in one of either the projection system or illumination system (col. 7 lines 38-39) as applied above, but does not explicitly teach a configuration in which a birefringent element is located in a path of the illumination optical system while an optical rotator is located in an optical path of the projection optical system.

Gerhard teaches an optical system for a lithographic apparatus (fig.'s 1-2, abstract) wherein a radial polarizer 5 for obtaining a radial polarization distribution is

located in an illumination system 1-7 (fig. 1 par. 19) and an optical rotator 14 is located in a pupil plane 15 of a projection optical system L1-L16 in order to convert the radial polarized light into tangentially polarized light (fig. 2 par. 23).

It would have been obvious to one of ordinary skill in the art to arrange a radial polarizer in an optical path of an illumination system as taught by Schuster, and further include an additional optical rotator located in an optical path of a projection optical system as taught by Gerhard in order to convert radially polarized light into tangentially polarized light.

For claim 46, Schuster teaches the limitations as applied to claim 30 above.

For claims 47-48, Schuster as modified by Levinson teach the limitations as applied to claims 97-98 above.

7. **Claims 102, 128** are rejected under 35 U.S.C. 103(a) as being unpatentable over Schuster (US 6,191,880) as applied to claims 99 and 120 above, in view of Fukami et al (WO 99/49504, cited in IDS).

For claims 102, 128, Schuster teaches that the optical system is used for lithography as applied to claim 49 above, but does not explicitly teach that the system could be used for immersion lithography, wherein the projection optical system forms the image of the predetermined pattern surface on the surface of the photosensitive substrate through a liquid.

Fukami et al teach a lithographic apparatus in which a projection optical system forms an image of a predetermined pattern surface on the surface of the photosensitive substrate through a liquid (fig. 1, p. 4 par. 4 – p. 5 par. 2 of translation provided by

Applicant) in order to optimize resolution and depth of focus (p. 4-5 of translation provided by Applicant).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the apparatus of Schuster to include the liquid immersion configuration taught by Fukami et al in order to optimize resolution and depth of focus in the system.

Response to Arguments

8. Applicant's arguments with respect to claims 30, 94 and 120 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to COLIN KREUTZER whose telephone number is (571) 270-7931. The examiner can normally be reached on Mon - Thurs from 9 AM - 4 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edward Glick can be reached on (571)272-2490. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/C. K./
Examiner, Art Unit 2882
9/20/2010

/Hung Henry Nguyen/
Primary Examiner of Art Unit 2882